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**TRI-SERVICE
CONFERENCE
ON CORROSION**



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**SHERATON PLAZA HOTEL
ORLANDO, FLORIDA**

PROCEEDINGS

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WARM WEATHER SURFACE TOLERANT COATINGS

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OBJECTIVE

TO INVESTIGATE COATINGS FOR NAVY USE IN SEAWATER BALLAST TANKS
THAT ARE:

SURFACE TOLERANT

CAN BE APPLIED IN WARM WEATHER (50°F OR GREATER)

SAFE TO USE

MEET CURRENT AND PREDICTED FUTURE ENVIRONMENTAL REGULATIONS

BACKGROUND

THESE TOUCHUP COATINGS ARE NEEDED SINCE COMPLETE GRITBLAST-
ING AND REPAINTING OF BALLAST TANKS WILL OCCUR WITH LESS FREQUEN-
CY IN THE FUTURE DUE TO THE EXPENSE AND ENVIRONMENTAL PROBLEMS.

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FINAL PRODUCT

FINAL PRODUCT WILL BE A MODIFICATION TO MIL-SPEC-23236B FOR TOUCHUP PAINTS DETAILING PRODUCT QUALIFICATION TEST PROCEDURE AND RECOMMENDED PAINTS FOR SURFACE TOLERANT APPLICATIONS.

APPROACH

SURVEY THE COMMERCIAL INDUSTRY FOR SURFACE TOLERANT COATINGS THAT PERFORM WELL AND DEVELOP SHORT TERM TESTING PROTOCOL FOR PREDICTING FIELD PERFORMANCE.

TEST PAINT CRITERIA

1. SURFACE TOLERANT OVER TIGHT CLEAN RUST
2. VOC LESS THAN 340 GR./LITER
3. CLOSE CUP FLASH POINT GREATER THAN OR EQUAL TO 100°F
4. EASY TO APPLY
5. AVOID CARCINOGENS, TOXIC MATERIALS, AND MINIMIZE SOLVENTS AND OTHER HAZARDOUS MATERIALS

LABORATORY AND MARINE SITE TESTING

32 PAINTS ARE CURRENTLY TESTED OVER HALF RUSTED AND HALF PAINTED PANELS AND TOTALLY RUSTED PANELS.

- A. SOLVENT BASED EPOXY
- B. 100% SOLIDS EPOXY
- C. WATER BASED EPOXY
- D. LATEX
- E. ACRYLIC EMULSION
- F. PRETREATMENTS

APPLICATION OF TEST PAINTS TO PANELS

- A. EACH TEST PAINT APPLIED TO 14 PANELS.
- B. PANELS GRIT BLASTED TO A NEAR WHITE METAL FINISH (2-3 MILS PROFILE).
- C. 6 PANELS ARE HALF PAINTED WITH MIL-P-24441 PAINT (NAVY FORMULA 150, 152 AND 151, TYPE 1).
- D. PAINT GIVEN 10 DAYS TO CURE.
- E. ALL PANELS ARE HUNG ON A FENCE BY THE CHESAPEAKE BAY TO CORRODE.
- F. AFTER CORRODING ABOUT 1 YEAR, THE PANELS ARE WIRE BRUSHED TO GIVE A TIGHT RUST. THE PAINT IS ALSO WIRE BRUSHED TO ROUGHEN THE SURFACE.
- G. TEST PAINT APPLIED TO ALL PANELS AT ONCE ACCORDING TO MANUFACTURES INSTRUCTIONS.
- H. THE CONTROL FOR EACH SET OF PAINTS BEING TESTED IS MIL-P-24441, TYPE 1 (NAVY FORMULA 150, 152 AND 151).

TEST PROCEDURES

- A. SALT SPRAY (ASTM B 117) FOR 3240 HOURS
- B. DEIONIZED 180⁰F HOT WATER IMMERSION BLISTER RESISTANCE TEST FOR 10 DAYS
- C. MARINE TEST SITE LONG TERM IMMERSION TEST
- D. FIELD TEST BEST PERFORMING TOUCHUP PAINTS ON NAVY SHIPS

MARINE TEST SITE

1. FOUR CONDITIONS ARE TESTED.
 - A. GALVANICALLY ISOLATED; UNSCRIBED (2 ALL RUSTED PANELS)
 - B. CONNECTED TO A ZINC ANODE; UNSCRIBED (2 ALL RUSTED PANELS)
 - C. CONNECTED TO A ZINC ANODE; SCRIBED (2 HALF PAINTED AND HALF RUSTED PANELS)
 - D. CONNECTED TO A ZINC ANODE; UNSCRIBED (2 HALF PAINTED AND HALF RUSTED PANELS)
2. PANELS IMMERSED IN SEAWATER FOR 3 MONTHS IN A DARK TANK. SEAWATER FILTERED TO PREVENT HARD FOULING, ONLY SLIME IS PERMITTED.
3. PANELS ARE AIR DRIED FOR 2 WEEKS IN A HUMID TANK.
4. CYCLE REPEATED UNTIL PANEL FAILS OR SIX CYCLES.
5. TO ENSURE BETTER REPEATABILITY IN FUTURE TESTING THREE PANELS INSTEAD OF TWO SHOULD BE TESTED.

RESULTS

RESULTS FOR BEST PERFORMING PAINTS ARE GIVEN AND COMPARED TO THE CONTROL (TYPE 1; F-150, 152 AND 151 POLYAMIDE EPOXY). THE FOLLOWING RESULTS WERE OBTAINED FOR 23 PAINTS TESTED. THESE PAINTS CONSISTED OF:

- A. HIGH SOLIDS SOLVENT BASED EPOXY
- B. WATER BASED EPOXY
- C. PRETREATMENTS
- D. 100% SOLIDS EPOXY PAINT

BEST OVERALL PERFORMING PAINT AT THE MARINE TEST SITE WAS A HIGH SOLIDS SOLVENT BASED EPOXY.

RATING PANELS

1. PANELS ARE RATED FOR THE FOLLOWING:

- A. % CORROSION USING EXTENT DIAGRAMS.
- B. BLISTERING USING ASTM D 714.
- C. UNDERCUTTING OF THE SCRIBE.
- D. DETERMINATION USING EXTENT DIAGRAMS.

2. PANELS WITH EXCESS CORROSION (5% OR GREATER) OR EXCESS BLISTERING (MEDIUM DENSE OR GREATER) FAIL AND ARE REMOVED FROM THE TEST.

ACCELERATED BLISTER RESISTANCE TEST

TEST PROCEDURE: 180°F, DEIONIZED WATER, 10 DAYS DURATION; OVER RUSTED PANEL

RESULTS

A. CONTROL: 3.5 *

TYPE 1 F-150, 152, 151 POLYAMIDE EPOXY

B. BEST PERFORMING PAINT IN THIS TEST: 5.5

ONE COMPONENT ALUMINUM PIGMENTED SOLVENT PAINT

C. HOW DID A GOOD HIGH SOLIDS SOLVENT BASED EPOXY PAINT PERFORM IN THIS TEST? 4.7

- * RATINGS FROM BLISTER POPULATION AND SIZE
- 10 BEST WITH NO BLISTERS
 - 0 WORST WITH TOTAL AREA BLISTERED

SALT SPRAY RESULTS

TWO ALL RUSTED AND TWO HALF PAINTED HALF RUSTED PANELS WERE TESTED FOR EACH PAINT SYSTEM. PANEL SIZE WAS 4" X 6".

- A. BEST PERFORMING PAINTS IN THIS TEST WERE: 100% SOLIDS EPOXY, HIGH SOLIDS EPOXY, MIL-P-24441, TYPE 1 (CONTROL)

HALF PAINTED - HALF RUSTED PANELS

TOP HALF: 0% CORROSION AND 0% BLISTERS
BOTTOM HALF: 0% CORROSION AND 0% BLISTER
SCRIBE: NO UNDERCUTTING

ALL RUSTED PANELS:

0% CORROSION AND 0% BLISTERING.
SCRIBE: NO UNDERCUTTING.

- B. HOW DID A GOOD HIGH SOLIDS SOLVENT BASED EPOXY PERFORM IN THIS TEST?

HALF PAINTED - HALF RUSTED PANELS

TOP HALF: 0% CORROSION AND 0 BLISTERS
BOTTOM HALF: 0% CORROSION AND 4 MD BLISTER
SCRIBE: NO UNDERCUTTING

ALL RUSTED PANELS:

0.01% CORROSION AND 6 M BLISTERING.
SCRIBE: NO UNDERCUTTING.

MARINE TEST SITE

AFTER 21 MONTHS EXPOSURE AT THE MARINE TEST SITE, THE FOLLOWING RESULTS WERE OBTAINED AND ARE BEING PROPOSED FOR THE MODIFICATION TO MIL-SPEC-23236B. 21 MONTHS WAS FOUND TO BE SUFFICIENT TO SCREEN COATINGS AND ACHIEVE A CORRELATION WITH SHIPBOARD RESULTS.

MINIMUM PERFORMANCE SPECIFICATION FOR WARM WEATHER TOUCHUP PAINTS
AFTER SIX CYCLES

Immersion Resistance Results.+

	%Corrosion		Blistering		Undercutting	
1. Attached to Zinc Anode, All Rusted, Unscribed	0.1%		2-8 MD		None	
2. Electrically Isolated, All rusted, Unscribed	0.3%		2-8 M**		None	
	Top	Bottom	Top	Bottom	Top	Bottom
3. Attached to Zinc Anode, Unscribed Half Rusted	0.1%	0.1%	2-8 MD	2-8 M**	None	None
4. Attached to Zinc Anode, Scribed Half Rusted"	0.1%	0.1%	2-8 MD	2-8 MD	1.5"	1.5"

+ For at least 2 of 3 panels, ignore effects within one inch of any edge
** 8 MD Blisters allowed

OVERALL RESULTS

1. THE NAVY HAS INVESTIGATED SURFACE TOLERANT COATINGS USING THREE SHORT TERM TESTS AND FIELD TESTS ON NAVY SHIPS.
2. FOR THE MARINE TEST THE BEST PERFORMING COATINGS BECOME APPARENT IN 21 MONTHS.
3. A TESTING PROTOCOL FOR SURFACE TOLERANT PAINTS HAS BEEN DEVELOPED. THE RESULTS FROM THE FIELD TEST CORRELATE WELL WITH THE MARINE TEST.